Results of the

Comprehensive Performance Evaluation

of the

Hardin Wastewater Treatment Facility

May 28-29, 2015

by

Montana Department of Environmental Quality

Water Pollution Control State Revolving Fund Program

Helena, Montana

Hardin, Montana
Comprehensive Performance Evaluation
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Introduction

Personnel from the Water Pollution Control State Revolving Fund (SRF) program of the Montana Department of Environmental Quality (MDEQ) conducted a Comprehensive Performance Evaluation (CPE) for the City of Hardin Wastewater Treatment Plant (WWTP) on May 28-29, 2015.

Comprehensive Performance Evaluations are conducted at wastewater treatment facilities as a means of assessing whether factors associated with administration, design, operation, or maintenance are affecting the performance optimization of the facilities as related to effluent quality. The CPE, a performance evaluation tool, is used by MDEQ to periodically assess the treatment capability of WWTPs in Montana. The CPE is based on the EPA Handbook: Retrofitting POTWs, and represents an essential part of MDEQ goals to protect state waters under the Montana Water Quality Act. The SRF staff conducts these evaluations as part of a statewide technical and financial assistance program benefiting Montana communities and improving wastewater treatment.

A CPE can be of value to community public utility departments in determining if the current wastewater treatment plant is capable of meeting state and EPA requirements for wastewater treatment without investing in a major facility upgrade and in achieving optimal treatment plant performance. The inspection team from the SRF staff combines engineering expertise in design and evaluation of wastewater collection and treatment systems and operational expertise to assist facilities achieve improved performance. Additionally, the SRF team uses this opportunity to familiarize themselves with each wastewater treatment plant, the limits to design and operational practices, as well as with treatment plant staff operators and administrators.

The CPE generates a prioritized list of performance limiting factors, which the facility should address to mitigate obstacles to optimizing treatment plant performance and to prevent NPDES permit violations. The CPE was conducted over a short period of time and does not represent a detailed engineering study of the facility.

This CPE was not prompted by identified problems at the WWTP or because of significant discharge permit violations. The Hardin facility was selected based on the periodic nature of the CPE program to evaluate mechanical wastewater treatment plants in Montana; assessing plant performance, control practices and identifying opportunities, if any, to optimize treatment strategies to improve treatment and reduce operating costs.

Facility Information

The City of Hardin WWTP is a 1.0 MGD facility designed to handle wastewater loads and flows for 7500 people. The facility, placed into service in 1980, is an extended aeration activated sludge facility, oxidation ditch bioreactor, that provides secondary treatment for the removal of pollutants such as: Biochemical Oxygen Demand (BOD), Total Suspended Solids (TSS), and pathogens.

The WWTP discharges treated effluent to the Bighorn River as permitted under the authority of the Environmental Protection Agency National Permitted Discharge Elimination System (NPDES) # MT0030759. Permit limits include, BOD, TSS, E. coli (pathogens), pH, and chlorine residual, with flow measurement required. The permit also requires that the facility collect one sample annually to be analyzed for total nitrogen (TN) and total phosphorus (TP). The operator typically collects this sample during the spring or summer months.

The facility processes include: a headworks facility equipped with flow measurement, a comminutor, and a rotary screen (the bypass channel has a bar screen); one oxidation ditch equipped with two rotary paddle aerators and two submerged mixers; two peripheral feed secondary clarifiers; an ultra-violet (UV) light disinfection system; one aerobic digester; and two sludge drying basins. Effluent flow is measured using a Parshall Flume, with electronic flow recording. Influent flow can be diverted to a lagoon cell (16.9 MG capacity) for emergency storage during high flow events or power outages.

The preliminary treatment process includes sampling, flow measurement, and screening in the headworks. Following preliminary treatment, secondary waste treatment is provided by the extended aeration oxidation ditch (activated sludge) and secondary clarifiers. Unless down for maintenance activities, both rotary paddle aerators and both submerged mixers operate continuously. This operational strategy provides excellent year- round BOD removal, as well as nitrification (the conversion of ammonia to nitrate) at least during the summer months when nutrients are analyzed.

Public health is protected by the open channel UV disinfection system that reduces pathogens in the final effluent to meet discharge permit standards.

Solids produced in the WWTP are removed from the plant flow by physical settling in the clarifiers and are primarily microbiological biomass, but contain an estimated 20% inert material. The settled solids are either returned to the activated sludge process through the use of screw pumps as return activated sludge (RAS) or removed from the process flow completely as waste activated sludge (WAS) for further solids treatment. Wasting controls the amount of biomass in the bioreactors and overall process performance.

Wasted sludge is sent to the aerobic digester for stabilization and odor control. The digester content is not thickened as past experience with the digester decants resulted in filaments being returned to the treatment process where it would lead to foaming issues. Furthermore, the sludge drying basins have adequate capacity to handle all of the non-thickened biosolids currently produced by the WWTP. Internal berms were constructed within an existing lagoon cell to create two drying basins. The solids will remain in the basins (typically 2 to 3 years) until adequately dry to pass the paint filter test for final disposal at the landfill.

Facility Physical Plant

The Hardin facility (See Figure 1 on Following Page):

Design Average daily flow: 1.0 MGD
Design Maximum Day: 1.22 MGD
Design Peak Hour: 1.4 MGD

Preliminary Treatment

- 15” Parshall flume with level transmitter (2 MGD)
- Comminutor – Muffin Monster
- Mechanical rotary screen micro strainer with washer/compactor
- Bypass 45-degree bar screen with 1” openings

Secondary Treatment

Aerobic Basin

- (1) Oxidation ditch aerobic reactor, 0.75 MG gallons
- (2) Paddle rotors – 25 hp
- (2) Submersible mixers (31,900 gpm each)

Clarification

- (2) 34-ft diameter center feed clarifiers, 10 feet depth
- (2) 700 gpm screw pump RAS
- (2) WAS pumps

Solids Handling

- (1) 34-ft diameter aerobic digester, 25-ft water depth, 170,000 gal capacity
- (1) 30-hp centrifugal blower, 500 CFM, diffuser assembly w/ eductor tube
- (2) sludge drying beds

Disinfection/ Flow Measurement

- Open channel, gravity flow, UV light
- Two units in series
- Capacity 2.0 MGD each unit (100% redundancy)
- 9” Parshall Flume with Ultrasonic effluent flow meter

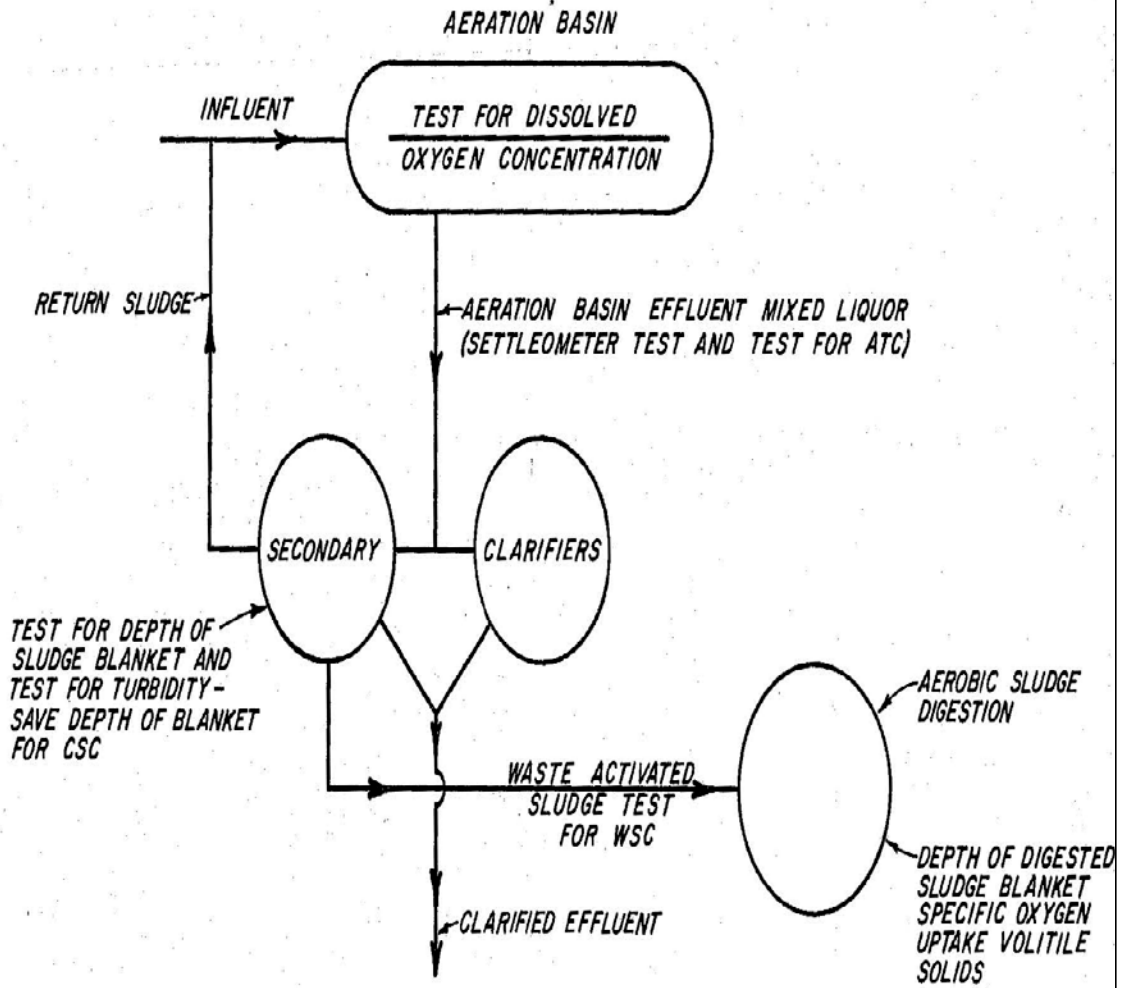


FIGURE 1

FLOW SCHEMATIC FOR HARDIN WASTEWATER TREATMENT FACILITY

NPDES Monitoring Program

Since the City of Hardin discharges to tribal waters, their discharge permit is administered by the Environmental Protection Agency (EPA). The Hardin WWTP is required to meet the following secondary treatment standards based on the permit conditions listed in NPDES permit # MT0030759:

The facility's current permit was issued on September 1, 2011 and will expire on August 31, 2016.

Current Hardin WWTP NPDES limits for the discharge to the Bighorn River at Outfall 001:

BOD_5	30 mg/L 30-day avg., 45 mg/L 7-day avg.
TSS	30 mg/L 30-day avg., 45 mg/L 7-day avg.
85% removal of BOD_5 and TSS	
E. coli Bacteria (April 1 through October 31)	126 cfu/100ml 30-day avg., 252 cfu/100ml 7-day avg.
E. coli Bacteria (November 1 through March 31)	630 cfu/100ml 30-day avg.,1260 cfu/100ml 7-day avg.
The pH maintained between	6.0 and 9.0 standard units

Sewage sludge (biosolids) handled and disposed of in manner to protect public health and environment

-sludge disposed of on land shall meet all applicable requirements of 40 CFR Part 503
-sludge disposed of in landfill shall meet all applicable requirements of 40 CFR Part 258

In addition to the limits listed above, the WWTP self-monitoring program includes sampling in the following areas:

<u>Outfall 001 – WWTP effluent</u>

Influent and Effluent Flow continuous; Influent BOD_5 and Influent TSS 1/month composite; Effluent BOD_5 and Effluent TSS 1/week composite; BOD_5 and TSS % removal calculated monthly; pH daily instantaneous; *E.coli* Bacteria 3/week grab; Total Ammonia 1/month composite; Nitrate + Nitrite 1/month composite; Total Kjeldahl Nitrogen 1/quarter composite; Total Phosphorus 1/quarter composite; Total Nitrogen calculated quarterly; Oil & Grease 1/month grab.

Please refer to NPDES Permit # MT0030759 for complete details on the Hardin discharge permit conditions.

Performance Evaluation

General

The Hardin Wastewater Treatment Plant (WWTP) is an Extended Aeration Activated Sludge facility, Oxidation Ditch that was put into operation in April 1980. The facility include a headworks facility equipped with a comminutor and rotary screen in the main channel and a bar screen in the bypass channel; a 0.75 MG oxidation ditch reactor equipped with two rotary paddle aerators and two submerged mixers; two peripheral feed secondary clarifiers; two screw pumps for RAS; an ultra-violet light disinfection system (2 banks); an aerobic digester; two sludge drying basins. Effluent flow is measured using a Parshall flume, with electronic flow recording. An existing lagoon cell (16.9 MG capacity) is utilized for emergency storage during high flow events.

Recent improvements have included: CIPP lining projects in 2004 and 2010, which included adding the rotary screen and comminutor, oxidation ditch mixers, and UV disinfection.

The WWTP performance is based on data from the 12 month time period (January 2014 to December 2014), generated by the plant's sampling and testing program. This data is used to represent the current operational performance relative to optimum capacity. This CPE seeks to establish plant ability to handle current loading and to effectively remove solids from the wastewater stream in order to optimize plant performance.

In general, the plant is well maintained and the operations staff has an active monitoring, operations and maintenance program that yields good compliance with NPDES permit requirements. The plant effluent data indicates that the plant achieves excellent BOD and TSS removal, and ammonia, which is not limited in the permit, is nearly completely removed. Note that nitrate and TN are not reduced due to lack of denitrification in the plant and these parameters might be limited in future permits.

Current WWTP Processes

Collection system – Lift stations (4)
Headworks processes - Comminutor and rotary screen
Secondary Treatment – 0.75 MG Oxidation Ditch
Secondary Clarifier – Peripheral feed, center weir (2)
Disinfection – UV
Effluent flow – 6" Parshall flume
Solids handling processes – Aerobic digester (1) and drying beds (2)
Ultimately to the landfill

Influent Loading & Solids Accountability Analysis

Based on a population of approximately 3,730 people, and using the influent BOD concentrations from the plant data for the calendar year of 2014, the approximate organic loading to the WWTP is about 841 lbs. of BOD per day. This results in a per capita organic contribution of about 0.22 lbs/person/day on an annual average basis. This is consistent with the conventional range of 0.17 to 0.20 lbs/person/day.

The amount of solids produced per lb of BOD removed is called the sludge production ratio. For this type of facility, we would expect a sludge production ratio of between 0.55 and 0.65. We will estimate the amount of sludge produced by the plant using the waste sludge volumes and

concentrations from the plant data for the period of the year 2014 to derive the pounds of solids wasted per day on an average basis. Using the plant influent organic loading data mentioned above, we will provide a sludge production ratio to the community with our final report.

Financial User Charge System

Currently the Hardin WWTP user charge and fiscal management system is structured as an independent fund. There are approximately 1,300 connections to the collection system. These are primarily residential, but the detention center and a few other commercial connections exist. However, there doesn't appear to be excessive loading to the plant from these connections. The collection system serves an existing population of approximately 3,730 persons. Current rates are set at a $32.94 per month (with water usage up to 7,200 gallons per month). Residents are metered. The user charge system is managed in accordance with statutory and accepted legal standards of practice.

The 2015 budget report and interviews with City staff reflect that current user charges allow for operations and management of the WWTP and generate adequate revenue for repayment of debts and required debt coverage. The current reserve balance is approximately $297,000 for equipment replacement and $78,000 for construction related activities.

In general, the User Charge system for Hardin is financially sound with sufficient revenues to cover O&M plus capital, but with limited replacement funds for major equipment or structures at the treatment plant. Considering the 35-year old major processes at the plant, the community may need to adjust rates to address any impending major improvements.

Unit Process Evaluation

The CPE team evaluated the Hardin WWTP major unit processes in order to assess their potential to achieve desired performance levels. If the major unit processes are found to be adequate, a major plant expansion or upgrades to the unit processes are not likely to be necessary to achieve design performance. Conversely, deficient capability in one or more of the unit processes indicates the need for major unit modification. The Hardin treatment plant unit processes were evaluated with respect to their capability to handle current loadings and with respect to their potential treatment capability. For this analysis current organic loading concentration to the system was projected for all flow rates.

To assess the plant capability relative to various loadings a performance potential graph (PPG) was developed. The assessed capability of the plant to meet desired performance is depicted in Figure 2. The major unit processes and evaluation parameters are listed on the left scale, and the scale of influent flows is listed along the top. The vertical broken line depicts the current flow to the facility. The shaded bars depict the evaluation team's rated capabilities of the plant treatment units. When interpreting the graph, it is important to remember that the projected capability represents the evaluation team's judgment concerning performance capability taking both design and operational parameters into account.

Summary: The plant unit processes were all rated adequate to provide the desired level of performance at current flows.

Oxidation Ditch: The first bar graph evaluates OD capacity (#BOD/1000 ft^3) for treating the organic load by supplying the necessary volume (HDT) and oxygen (#O_2/#BOD) in the basins. These bars are located directly beneath the bars representing current BOD loading conditions: BODLR, HDT and OR (BOD Loading Rate, Hydraulic Detention Time and Oxygen Requirement, respectively). The capacity of the OD, organic and hydraulic loading, and Oxygen Supply System are adequate to treat current waste loads and appear to be adequate to design flows and loads.

Secondary Clarifiers: The clarifiers are rated beyond the current plant flows and seem adequate to handle the design capacity of 1.0 mgd.

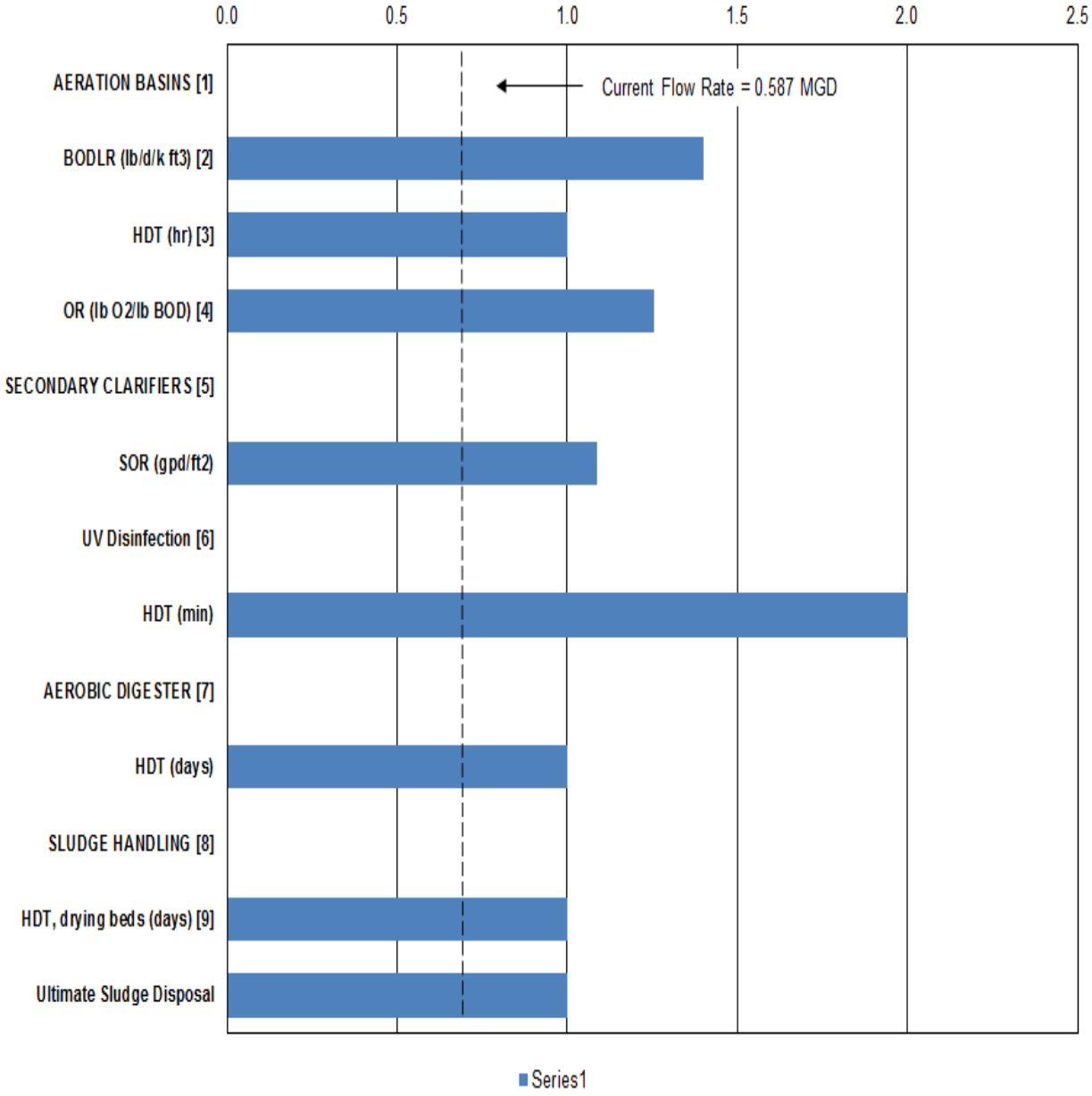
Ultra-violet (UV) Disinfection: The UV system was rated past current flow, to design plant flows.

Aerobic Digester: The digestion process was rated adequate for the current level of sludge production, but might be limited in capacity relative to design loads and solids production.

Sludge Handling: These processes were not rated during this evaluation. Two sludge drying basins provide on-site storage of sludge until adequately dewatered (typically 2 to 3 years). Ultimate disposal is in the landfill and not limited at this time.

Please contact the CPE team at DEQ for further explanation of these unit process ratings.

FIGURE 2. Hardin, MT Wastewater Treatment Plant 2015 Major Unit Process Evaluation (1980 Design Flow 1.0 MGD)



Performance-Limiting Factors

During the evaluation, potential performance-limiting factors in the areas of design, administration, operation and maintenance were assessed. The factors identified were classified as A, B or C as follows:

A - Major effect on a long-term repetitive basis
B - Minimal effect on a routine basis or major effect on a periodic basis
C - Minor effect

The Hardin Plant is classified as an Extended Aeration Activated Sludge - Oxidation Ditch Facility. The Hardin WWTP was placed into operation in 1980 with an upgrade to the headworks facility in 2006 and an upgrade to the disinfection system in 2009. The facility was designed for and is capable of meeting secondary removal criteria within the City's existing NPDES permit. It is operating in compliance with the existing permit and records reflect the facility is doing an excellent job of BOD, TSS, and *E.coli* removal.

Out of over 70 factors considered, the CPE team identified: Three (3) B factors and two (2) NR – No Rating factors. The CPE team added the two (2) NR factors as issues of concern to be addressed, but that are not likely to affect treatment optimization at this time.

Maintenance – Equipment Age (B)

AWWTP operational strategy for process control in the OD is to try to maintain a suitable DO level, but the water level control weir for the OD effluent does not function properly and the DO level is based on a constant OD water level. The headworks screening and grinding equipment shows signs of advanced corrosion and other structural problems that create problems in the downstream processes.

Design – Plant Loading – I/I (B)

High stormwater flows force the system to bypass to an emergency lagoon, and the organic load is bypassed, as well, since the flows are evaporated in the pond and not returned to the main plant flow. Additionally, the high infiltration and inflow sources have other effects on plant processes.

Design – Unit Design Adequacy - Preliminary (B)

The screening and grinding equipment has been corrosively degraded in the headworks building. The preliminary treatment system bypasses excessive material into the downstream processes. Operator safety may be impacted by the atmosphere in the building.

No Rating (NR)

The secondary clarifier weir is not level and could lead to diminished performance due to short-circuiting; the Oxidation Ditch tilting weir is inoperable; the UV system is exposed to bitter cold temperatures in the winter causing problems with the UV light bulb cleaning and maintenance program.

No Rating (NR)

The design of the Oxidation Ditch includes surface aerator rotors, one on each side, and two mixers installed on the ditch floor near the first set of rotors for mixing without aeration. The WWTP has opportunities to achieve advanced level treatment, reducing

nitrogen and phosphorous, while achieving cost savings though reducing energy and chemicals by cycling an aerator rotor on and off, and using the mixers to keep the biomass in suspension during the off period. Additional possibilities include, using VFD controls on the aerobic digester blower motors and repairing the tilting weir in the OD for better DO control.

Summary

Three B factors and two NR concerns were identified during the CPE that either affect or can affect the Hardin WWTP performance. Achieving long-term compliance with NPDES permit conditions is a goal for wastewater treatment facilities. It is the evaluation team's judgment that the Hardin wastewater treatment facility operating team will make good progress toward achieving this goal if the performance-limiting factors identified in this report are addressed. At this time, additional technical assistance from the WPCSRF program at DEQ does not appear to be warranted.

As part of the CPE process, this office would like to have the city provide a written response to this report within 60 days of receiving it. The response would describe efforts your community is taking to deal with the factors listed above. The response can be sent to the DEQ at the address listed on the letterhead of the cover letter to the attention of Bill Bahr. Please feel free to call 406-444-5337 with any comments, corrections, or suggestions.